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The Macroeconomic Effects of European Financial Development: a heterogenous panel analysis

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The Macroeconomic Effects of European Financial Development: a heterogenous panel analysis*

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Abstract

This paper investigates the macroeconomic benefits of international financial integration and domestic financial sector development for the European Union. The sample consists of 26 European countries with annual data during the period 1970–2004. We attempt to exploit more fully the temporal dimension in the data by making use of the common correlated effects (CCE) estimator. We also account for the nonstationarity of time series by employing the cross-section augmented panel unit root test of Pesaran (2007) and recently developed panel cointegration techniques. We check the robustness of these results by using the fully modified OLS method of Pedroni (2000). Our empirical results suggest a relationship between domestic financial sector development and labour productivity. We report evidence that real GDP per worker is positively linked to a measure of international financial integration (stock of international financial assets and liabilities expressed as a ratio to GDP). We also try to disentangle the effects on real GDP per worker of different types of capital flows (FDI, Portfolio equity, Debt) and are able to identify a significant positive effect on GDP per worker of debt inflows which we could attribute to the institutional environment that has been fostered by the European Union.

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1 Introduction

This paper assesses the macroeconomic benefits of international financial integration and domestic financial sector development in Europe. There is an extensive literature that explores the macroeconomic benefits of financial integration[1]. As Obstfeld (2008) has pointed out the conclusion one might glean from the many studies that have been conducted is that it would be very hard to find a strong and robust relationship between capital account liberalization and growth or macroeconomic volatility, especially for developing countries.

The theoretical literature proposes various direct mechanisms through which financial globalization could benefit countries that pursue it. One theoretical channel of gain is improved risk sharing which, in principle, could reduce the level of consumption volatility relative to output. Obstfeld (2008) argues that there is no reliable empirical evidence that such volatility reductions have occurred in developing countries as a result of financial liberalization. A second major channel of gain would be the alleviation of capital scarcity in developing countries. Capital account liberalisation, in principle, generates flows from capital-abundant towards capital-scarce countries and, perhaps transitionally, accelerates economic growth as it would help low-income countries to expand investment beyond their national savings. In terms of evidence on the financing channel, a massive body of empirical papers has often found mixed results, suggesting that the growth benefits of liberalisation are not straightforward.

There exists a large related literature that could be helpful for understanding why the empirical evidence on the macroeconomic effects of capital account liberalization is rather mixed. Certain threshold conditions have to be met before a country is expected to benefit from financial integration. There is plenty of anecdotal evidence that external opening of the capital account without having prepared the ground before hand by institutional and governance reforms, can make the country vulnerable to sudden stops. Kose et al. (2006), delineate a set of threshold conditions that can affect the level of benefits countries reap from capital account liberalization: 1) domestic financial-sector development and regulation, 2) general institutional quality, 3) a stable macroeconomic environment and 4) the degree of openness to trade. They argue that it is the interaction between financial integration and this set of threshold conditions that determines the outcome for growth and volatility. They also present a detailed discussion of the empirical evidence on each of these preconditions (for example, Alfaro et al., 2004; Chinn and Ito, 2006; Klein and Olivei, 2008; Kose, Prasad, and Taylor, 2008).

Must capital account liberalization therefore await those threshold conditions to be met? Kose et al. (2006) indicate that the answer is no, based on the grounds that cross-border financial integration itself positively contributes to domestic financial sector development, the quality of institutions, and to macroeconomic stability. There is the potential for a substantial long-term economic payoff via the *collateral benefits* conferred by these indirect effects, even for emerging countries. Therefore, it is not just the capital inflows themselves, but these positive spillovers, that drives the benefits of financial openness. A corollary of the above argument is that the indirect benefits of financial integration ultimately express themselves in total factor productivity (TFP) growth and macroeconomic stability. Research on these potential collateral benefits is limited, but is growing rapidly. One study is that of Tytell and Wei (2004), who present a disciplining

[1] For some recent surveys of this literature see Eichengreen (2001), Obstfeld and Taylor (2004), Obstfeld (2008), Kose et al., (2006), Henry (2007), and Prasad and Rajan (2008).

effect of financial integration on monetary policy. In another study, Kose, Prasad, and Terrones (2008), investigate the relationship between financial openness and TFP growth for a large sample of countries over the period 1966–2005. They break the data up into non-overlapping 10-year averages and use lagged regressors as instruments to address potential endogeneity concerns. Their results indicate that de jure financial openness has a statistically significant positive impact on TFP growth. They also find a tendency for external FDI and portfolio equity liabilities to boost TFP growth, but for external debt liabilities to lower it.

As noted above, equity market liberalization, direct foreign investment, and short-term debt flows might have very different macroeconomic effects. An alternative line of research into the benefits of financial integration is based on the composition of capital flows. Equity market liberalization appears to be robustly associated with a positive effect on economic growth (Bekaert et al., 2005). The evidence that FDI increases growth is less conclusive, although recent work has begun to come up with more positive evidence. In contrast, the empirical literature is fairly decisive about short term debt liabilities lowering the beneficial effects of capital inflows (Reisen and Soto 2001). In principle, FDI and international portfolio equity flows are not only presumed to be more stable and less prone to reversals, but are also believed to bring with them many of the collateral benefits of financial globalization (Kose et al. 2006).

In this paper we take a different approach in order to explore the relationship between domestic financial development, international financial integration and macroeconomic performance. The vast majority of existing studies focus on the effects on the rate of economic growth, even though most models in the Solow/Romer tradition suggest that the effects on growth should be transitory, though permanent for the level of per capita income. So we concentrate on the levels effects of financial development. Since the data we are working with are nonstationary this means that potentially we can exploit the superconsistency properties of cointegrating systems to address inevitable biases coming from endogeneity and omitted variables[2]. We adopt two econometric approaches. To address issues of slope heterogeneity and cross sectional dependence in a dynamic panel we use the common correlated effects estimator of Pesaran (2006). We contrast this with the fully modified OLS estimator of Pedroni (2000). Using data on countries in the European Union since 1970 we find evidence for a systematic effect of the degree of financial development on levels of per capita income.

There are a number of grounds on which the econometric evidence on the growth enhancing effects of financial integration may be questioned: The literature primarily relies on cross-sectional approach to testing the growth effects of financial opening. The absence of a clearly specified theoretical framework within which openness could affect growth is believed to be a major problem in interpreting the findings of this literature. In a recent paper, Henry (2007) calls into question the usefulness of cross-county approach to testing the relationship between capital account liberalization and growth. He argues that the capital deepening channel of gain should imply only a temporary, rather than permanent, increase in growth from financial integration, but most of the cross-sectional studies that have been conducted do not really test this. It would make more sense to look econometrically for an effect of the level of financial openness on the level of per capita GDP and exploit more fully the temporal dimension in the data. Such an approach allows one to address the point made by Henry (2007) that the growth effects of financial integration may be temporary.

[2]For a review of the literature on nonstationarity in panels see Banerjee (1999).

Another strand of research that has been pursued is the use of homogeneous panel data approaches such as fixed and random effects estimators, the instrumental variable (IV) technique proposed by Anderson and Hsiao (1981, 1982), and the generalized methods of moments (GMM) model of Arrelano and Bond (1991), Arrelano and Bover (1995) among others. Homogeneous panel data models allow the intercepts to differ across groups while all other parameters are constrained to be the same (a high degree of homogeneity is imposed). As discussed in Pesaran and Smith (1995), the problem with these dynamic panel data techniques, when applied to testing the growth effects of financial openness, is that they can produce inconsistent and potentially very misleading estimates of the average values of the parameters, as growth models typically exhibit substantial cross-sectional heterogeneity. Other grounds on which the econometric evidence is likely to be problematic is the presence of cross-sectional dependence of the shocks to the output growth process which was not addressed in any of the previous papers.

We should note that an endogeneity problem is perhaps the most important reason for being skeptical of all the econometric work suggesting a positive (negative) association between financial integration and growth (macroeconomic volatility). Countries may liberalize when they expect improved growth opportunities or when low macroeconomic volatility is predicted. Besides, financial opening may be bundled with a potential host of other growth-friendly reforms, be they of policies or institutions. A few papers have attempted to deal with this problem by using IV and GMM techniques in dynamic panel regressions. Kose et al. (2006), argue that the endogeneity problem may ultimately be intractable in macroeconomic data and suggest looking at more disaggregated data.

Based on anecdotal evidence, Lane (2008) argues that European experience is much more positive in terms of the relationship between financial openness and economic growth than is the case for other groups of non-advanced economies. The argument is that the European Union has provided a unique institutional environment for financial openness to generate macroeconomic benefits. We investigate, econometrically, whether the institutional anchor provided by EU membership matters in shaping the effects of financial integration on European countries level of real GDP per worker. More specifically, this paper looks for an effect of the level of financial openness on the level of real GDP per worker and exploit more fully the temporal dimension in the data by employing second generation panel unit root tests and cointegration techniques.

We account for cross-sectional dependencies that arise potentially from multiple common factors, and allow the individual responses to these factors to differ across countries. A possible source of cross-sectional dependency would be due to world-wide common shocks that affect all cross section units. Changes in technology is an example of such common shocks that may affect real GDP per worker, but with different degrees across countries.[3] We make use of the common correlated effects (CCE) estimator of Pesaran (2006), a sufficiently general and flexible econometric approach, that is consistent under both cross-section dependence and cross-country heterogeneity.

It is very important to recognize that the financial integration experience of different countries around Europe exhibits a substantial degree of heterogeneity. Therefore, it would be very misleading to pool together the full range of countries (high income and recently acceded countries) into a panel regression equation with common dynamics. Instead, studying the macro effects of financial integration by the means of heterogeneous panel data approach is a valuable option. This is the line of enquiry that we pursue. We

[3] Different forms of cross section dependence are discussed and formally defined in Pesaran and Tosetti (2007).

also attempt to disentangle the effects on real GDP per worker of different types of capital flows (FDI, Portfolio equity, Debt) by looking at them in a common framework.

The plan of the paper is as follows. Section 2 discusses the patterns of financial integration in Europe. Section 3 provides a breif review of the panel data model and estimation methods. Section 4 reports the estimation results and section 5 provides some concluding remarks.

2 Patterns of European Financial Integration

The literature has used both de jure and de factor (volume- or price-based), indicators of cross-border financial integration. De jure measures are understood to suffer from a variety of well-known shortcomings, however; see Kose et al. (2006), for a through discussion. In our view, volume-based indicators provide the best available measure of a country's de facto integration with global financial markets. The quantity-based indicators that we use in this paper draw upon the work of Lane and Milesi-Ferretti (2007), who have assembled an extensive dataset of total foreign assets and liabilities for 145 countries over the period 1970-2004. Their dataset also contains information about the composition of international financial positions, including FDI, international portfolio equity, external debt, and official reserves.

Figure 1 compares the evolution of de facto financial integration measures (stock of international financial assets and liabilities expressed as a ratio to GDP based on the Lane-Milesi-Ferretti data) for three groups of countries: EU-15; the CEE group of recently acceded members of the EU from Central and Eastern Europe; and EU-27 group with all members of the EU. The results show that the EU-15 economies have become substantially integrated into global financial markets. For Central and Eastern European countries, although average de facto openness grew rapidly over the last decade but it is still far below that of high-income members of the EU.

Table 2 gives a summary of the sources of external financing of European countries. A few things can be noted from this table. Foreign direct investment has become quite important for CEE economies, although debt still accounts for more than half of the stock of all external liabilities. The share of debt in gross stocks of foreign assets and liabilities for CEE countries declined sharply from 96 percent in 1980-84 to 50 percent in 2000-04. For recently acceded members of the EU from Central and Eastern Europe, FDI and portfolio equity shares rose from 0.97 percent in 1980-84 to around 34 percent in 2000-04, reflecting the wave of mergers and acquisitions, privatization of state firms, and stock market liberalizations that spurred flows to these economies in the early- to mid-1990s. However, the share of portfolio equity still remains very low for CEE countries reflecting their underdeveloped stock markets. In recent years, the accumulation of official international reserves has accounted for a significant portion of the increase in gross foreign assets of CEE economies; consequently, the share of the "other" category has jumped over the last decade. For EU-15 countries, the biggest increase has been in the share of portfolio equity; while debt financing remains the most important source of flows for these countries.

3 The Econometric Model and Tests

The key empirical equation that we estimate takes the following form:

$$y_{it} = \alpha_i + \beta_{i1} i_{it} + \beta_{i2} fi_{it} + \beta_{i3} fd_{it} + u_{it}, i = 1, 2, ..., N; t = 1, 2, ..., T, \tag{3.1}$$

where y_{it} is real GDP per worker in the i^{th} country during year t. Likewise $i_{it} = \ln(I/Y)_{it}$ represents the investment share, fi_{it}, and fd_{it} are measures of international financial integration and domestic financial sector development, respectively. α_i represents the country specific fixed effects. We consider this equation as a long-run, or equilibrium relationship. The short run dynamics and their adjustments to the long-run equilibrium across countries can be accommodated through the error terms, u_{it}.

As is clear from equation (3.1) the parameter vector of the slope coefficients, $\boldsymbol{\beta}_i = (\beta_{i1}, \beta_{i2}, \beta_{i3})'$, is allowed to be heterogeneous across countries. In order to assess the overall effects of covariates, in this paper we shall focus mainly on the estimation of the average value of $\boldsymbol{\beta}_i$, namely $E(\boldsymbol{\beta}_i) = \boldsymbol{\beta}$, assuming a random coefficient model, $\boldsymbol{\beta}_i = \boldsymbol{\beta} + \boldsymbol{\varpi}_i$, where $\boldsymbol{\varpi}_i \sim IID(\mathbf{0}, \mathbf{V}_{\varpi})$.

We shall assume that u_{it} has the following multi-factor structure

$$u_{it} = \boldsymbol{\gamma}_i' \mathbf{f}_t + \varepsilon_{it}, \tag{3.2}$$

in which $\mathbf{f}_t$ is a $m \times 1$ vector of unobserved common shocks (or factors), and ε_{it} are the individual-specific (idiosyncratic) errors assumed to be distributed independently of regressors and $\mathbf{f}_t$. However, we allow ε_{it} to be weakly dependent across i, and serially correlated over time. The pattern of serial correlation in ε_{it} could vary across i (Pesaran, 2006). The common factors, $\mathbf{f}_t$, can also be serially correlated and possibly correlated with i_{it}, fi_{it} and fd_{it}. Furthermore, $\mathbf{f}_t$ is allowed to be stationary or nonstationary (Kapetanios et al., 2006).

Despite its simplicity the above specification is reasonably general and flexible and allows us to consider a number of different factors that drive labor productivity. In particular, some of the factors that are difficult to measure accurately can be captured through the unobserved common components of u_{it}

We use the Common Correlated Effects (CCE) type estimator, which asymptotically eliminates strong as well as weak forms of cross section dependence in large panels (Pesaran, 2006). We use two estimators of the mean value of $\boldsymbol{\beta}_i$. First, the CCE mean group estimator (CCEMG) is a simple average of the individual CCE estimators, $\hat{\mathbf{b}}_i$ of $\boldsymbol{\beta}_i$. Second, if the individual slope coefficients, $\boldsymbol{\beta}_i$, are the same, efficiency gains can be achieved from pooling observations over cross section units.

We test for cross-section dependence in the errors using the CD test of Pesaran (2004)[4] The CD test is based on an average of the pair-wise correlations of the OLS residuals from the individual regressions in the panel, and tends to a standard normal distribution as $N \to \infty$.

One of the most commonly used tests for unit roots in panels is the (IMS) test of Im, Pesaran and Shin (2003). However, the IPS test procedure is not valid if the series are cross-sectionally dependent. A number of panel unit root tests that allow for possible

[4] Frees (1995) also proposes tests based on average pair-wise sample correlations of the series across the different cross-section units. His R_{AVE} test statistic is based on Spearman rank correlations, and his C_{AVE} test statistic is based on Pearson rank correlations. The latter is closely related the CD test also considered in Pesaran (2004).

cross section dependence in panels have been recently proposed in the literature. Here we consider the simple test proposed by Pesaran (2007), which follows the CCE approach and filters out the cross section dependence by augmenting the ADF regressions with cross section averages.

Numerous panel cointegration tests have been proposed recently in the literature that address possible error cross section dependence. Among these are the tests proposed by Bai and Kao (2006), Banerjee and Carrion-i-Silvestre (2006), Chang (2005), Gengenbach et al. (2006), Groen and Kleibergen (2003), Nelson, Ogaki and Sul (2005), Pedroni and Vogelsang (2005) and Westerlund (2005). The tests by Groen and Kleibergen, Nelson, Ogaki and Sul, and Westerlund are applicable when N is small and T large. The tests of Banerjee and Carrion-i-Silvestre, Chang, Pedroni and Vogelsang, in principle, can deal with panels where N is reasonably large, but they do not allow the unobserved common factors to be correlated with the observed regressors Bai and Kao allow for cross section dependence using a factor approach, but they do not allow cross-sectional heterogeneity in the cointegrating vector. Gengenbach et al. propose a sequential procedure where in the first step unit root properties of the (extracted) common factors and idiosyncratic components are investigated, and depending on the outcomes non-cointegration of the common factors and/or the idiosyncratic components are then investigated. To deal with the joint nature of these tests, Gengenbach et al. suggest using the Bonferroni procedure, but based on Monte Carlo simulations they find the joint tests to be undersized.

4 Empirical Results

We begin our empirical investigation with a preliminary test of cross section dependence, using data on real GDP per worker, investment shares of real per capita GDP, three different indicators of international financial integration, and measures of domestic financial development. Table 1 defines the variables used. A more detailed description is provided in the Data Appendix. We use annual data on 26 European countries, excluding Luxemburg, from 1970 to 2004.

The extent of cross section dependence of the residuals from the ADF(p) regressions of real GDP per worker, international financial integration, domestic financial sector development, and investment shares over the period 1970 to 2004 are summarized in Table 3. For each $p = 1, 2$, and 3 we report CD test statistics which clearly show that the cross correlations are statistically highly significant, and thus invalidate the use of panel unit root tests that do not allow for error cross section dependence, such as the IPS test. Therefore, in what follows we shall focus on Pesaran's $CIPS$ tests.

The CIPS test results, summarized in Table 4, support the hypothesis of a unit root in most variables including investment shares[5] (if the trended nature of these variables are taken into account), as well as zero order integration in first differences. This conclusion seems robust to the choice of the augmentation order of the underlying CADF regressions. However, the CIPS test results based on the CADF regressions with intercepts and no trend, do not support the unit root hypothesis for all variables and for all $p = 1, 2$, and 3. In particular,the null hypothesis is convincingly rejected for the domestic money bank to CB assets measure of financial development in CADF regressions with intercepts only.

[5] As Pedroni (2008) notes the investment/income share can only be locally nonstationary. It is naturally bounded as a ratio between zero and one. But for purposes of estiamtion in a dynamic cointegrating panel local nonstationarity is a helpful property.

The next step in our empirical strategy is to estimate the coefficients of equation (3.1).In view of discussion in Section 3, the common correlated effects (CCE) estimators are consistent regardless of $f_{\ell t}$ being stationary or non-stationary, so long as ε_{it} is stationary and m is a finite fixed number (See Pesaran, 2006, Kapetanios *et al.*, 2006). The common correlated effects (CCE) estimators are based on the cross section augmented regressions

$$y_{it} = \alpha_i + \beta_{i1} i_{it} + \beta_{i2} fi_{it} + \beta_{i3} fd_{it} + d_{i0}\overline{y}_t + d_{i1}\overline{i}_t + d_{i2}\overline{fi}_t + d_{i3}\overline{fd}_t + e_{it}, \tag{4.1}$$

where $\overline{y}_t, \overline{i}_t, \overline{fi}_t$ and $\overline{fd}_t$ denote the simple cross section averages of y_{it}, i_{it}, fi_{it}, and fd_{it} in year t. For purposes of comparison we first report Mean Group and Fixed Effects results in Table 5. The coefficient on the investment to income ratio is particularly sensitive to the inclusion of measures of international and domestic financial development. There is also evidence, not surprisingly of cross section dependence. In Table 6 we report the common correlated effects mean group (CCEMG) and the common correlated effects pooled (CCEP) estimates. The coeficients on the investment income ratio are now much more stable across differen specificationsMost importantly for our purposes, the CCEMG and CCEP estimates of the financial development parameters, are all positive and statistically significant which means that labour productivity is positively linked to the measure of domestic financial development (private credit to GDP) in the long run. The coefiicents on the financial integration measure are well determined and in three cases significant in the CCEMG and CCEP regressions. They reveal positive and significant effects on real GDP per worker of European financial integration. Our results indicate that European experience is much more positive in terms of the relationship between financial openness and growth than is the case for other groups of non-advanced economies. This may reflect the possibility that the European Union has provided a unique institutional environment for financial openness and macroeconomic benefits have flown from this. The debt liabilities variable is also highly significant in both the CCEMG and CCEP regressions. Notwithstanding the suggestive results there is still evidence of cross section dependence. However, when for the CCE if we exclude the newer members of the European Union and confine ourselves to the EU-15 group in this case cross sectional dependence is substantailly reduced. A possible explanation is that the an unobervable common factors among the newer members themselves that are not been properly captured by the cross section averages across the whole of the European Union.

4.1 Panel Cointegration Test Results

The residuals $\hat{u}_{it}$ defined above can now be used to test the null of non-cointegration between y_{it} and $\mathbf{x}_{it}$. Note that the CCE estimates are consistent irrespective of whether $\mathbf{f}_t$ are $I(0)$, $I(1)$ and/or cointegrated. The presence of $\mathbf{f}_t$ also requires that the panel unit root tests applied to $\hat{u}_{it}$ should allow for the cross section dependence of the residuals. The extent to which these residuals are cross-sectionally dependent can be seen from the CD test statistics which are reported in Table 6.

We computed CIPS(p) panel unit root test statistics for $\hat{u}_{it}$, including country specific intercepts, for different augmentation and lag orders, $p = 1, 2$,and 3, and obtained the results, $-3.35, -3.28$, and -3.16, respectively. The 5% and 1% critical values of the CIPS statistic for the intercept case with $N = 16$ and $T = 35$ are -2.17 and -2.34, respectively. The results suggest rejection of a unit root in $\hat{u}_{it}$ for all the augmentation orders at 5% and 1% levels and support the existence of a cointegration relationship among real GDP per worker, international financial integration, domestic financial sector development, and investment shares.

4.2 FMOLS Results

In Table 7 we turn to the full adjusted OLS method of Pedroni.In this section we describe the details of alternative estimation and testing procedures that we employ for the nonstationary panel specification. The first step in our empirical analysis is to test for panel unit roots in real GDP per worker, international financial integration, domestic financial sector development, and investment shares over the period 1970 to 2004. As we argued in section **??**, the CIPS tests are unable to reject the null hypothesis of a unit root in the data for all members of the panel. Next we attempt to confirm that permanent changes in investment shares, international financial integration, and domestic financial sector development are associated with permanent changes in real GDP per worker in the form of a cointegrating relationship. We apply Pedroni (1999) tests for the null hypothesis of no cointegration to the regression residuals from the hypothesized cointegrating regression. We report, in Table 7, three panel cointegration test statistics based on a group mean approach. The first one is analogous to the Phillips and Perron rho-statistic, and the other two are analogous to the Phillips and Perron t-statistic (non parametric) and the augmented Dickey-Fuller t-statistic (parametric).[6] The results generally suggest the existence of a cointegrating relationship among these variables for the raw data as well as data that have been demeaned with respect to the cross-sectional dimension for each time period. The demeaned version serves to extract common time effects from the data and the results can be interpreted as accounting for certain forms of cross-sectional dependency.

The FMOLS group mean estimates and the corresponding standard errors are reported in Table 8 for the case in which we have used raw data as well as the case in which the data have been demeaned over the cross-sectional dimension in order to account for simple forms of cross-sectional dependence through common time effects. We find credible estimates for the slope parameters which are superconsistent under cointegration, and converge at rate $T\sqrt{N}$. This property permits us to obtain much more accurate estimates than would be possible with conventional methods. Furthermore, the point estimates for the group mean values are reasonable despite the fact that our panel regression does not include direct proxies for the unobserved intangible factors, and despite the possible endogeniety of the regressors.

5 Concluding Remarks

This paper has considered the relationship between real GDP per worker and financial integration/development in a panel made up of 26 European countries over 35 years, where there is a significant degree of cross-country heterogeneity and cross-section dependency. We find positive and significant effects on real GDP per worker of European financial integration and domestic financial sector development once we take proper account of both heterogeneity and cross sectional dependence. We do this by employing the common correlated effects estimators of Pesaran (2006) that use a multifactor error structure with unobservable common factors. We are able to identify a significant positive effect on

[6] The discussion and mathematical expositions of these statistics is contained in Pedroni (1999).

GDP per worker of debt inflows which can be attributed to the unique institutional environment that European Union has provided for member countries. We also report the fully modified OLS estimates of Pedroni which he argues are more invariant to possible endogeneity and omitted variables than the CCE approach.

Given the high degree of uncertainty in the empirical work in this area, our results are no more than encouraging. Nevertheless, they do suggest that modelling integrated dynamic panels with heterogeneity and unobserved cross section dependence may be a better way of uncovering the sorts of low frequency, slow moving effects of financial developement both domestically and internationally on aggregate income, rather than reliance on the high frequency properties of growth regressions common in the literature.

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Table 1: List of Variables and their Sources

Real GDP per worker	Summers & Heston (1991)
Investment share of real GDP per capita	Summers & Heston (1991)
Stock of total assets and liabilities (%GDP)	Lane and Milesi-Ferretti (2007)
FDI & Equity (%GDP)	Lane and Milesi-Ferretti (2007)
Debt (%GDP)	Lane and Milesi-Ferretti (2007)
Domestic money bank to central bank assets	Beck, Demirguc-Kunt and Levine, (2006)
Liquid liabilities to GDP	Beck, Demirguc-Kunt and Levine, (2006)
Private credit to GDP	Beck, Demirguc-Kunt and Levine, (2006)

Notes: Annual data between 1970 and 2004 ($T = 35$) for 26 European Countries ($N = 26$).

Table 2: Gross Stocks of Foreign Assets and Liabilities (Millions of $)

	1970-74	1980-84	1990-94	2000-04
EU-27	49278	188285	547413	1675653
Equity Share	6.21	4.23	8.59	15.76
FDI Share	17.58	13.01	16.00	20.32
Debt Share	71.11	79.98	73.05	61.85
Share of Other	5.10	2.78	2.36	2.07
EU-15	54529	233454	882100	2969244
Equity Share	5.77	4.00	8.51	15.95
FDI Share	16.43	12.12	15.78	20.20
Debt Share	71.18	79.82	72.81	61.99
Share of Other	6.62	4.06	2.89	1.87
CEE	-	27111	24957	61785
Equity Share	-	0.00	0.56	4.22
FDI Share	-	0.97	4.78	29.57
Debt Share	-	96.63	86.57	50.01
Share of Other	-	2.40	8.08	16.20

Figure 1: European Financial Integration, 1970-2004

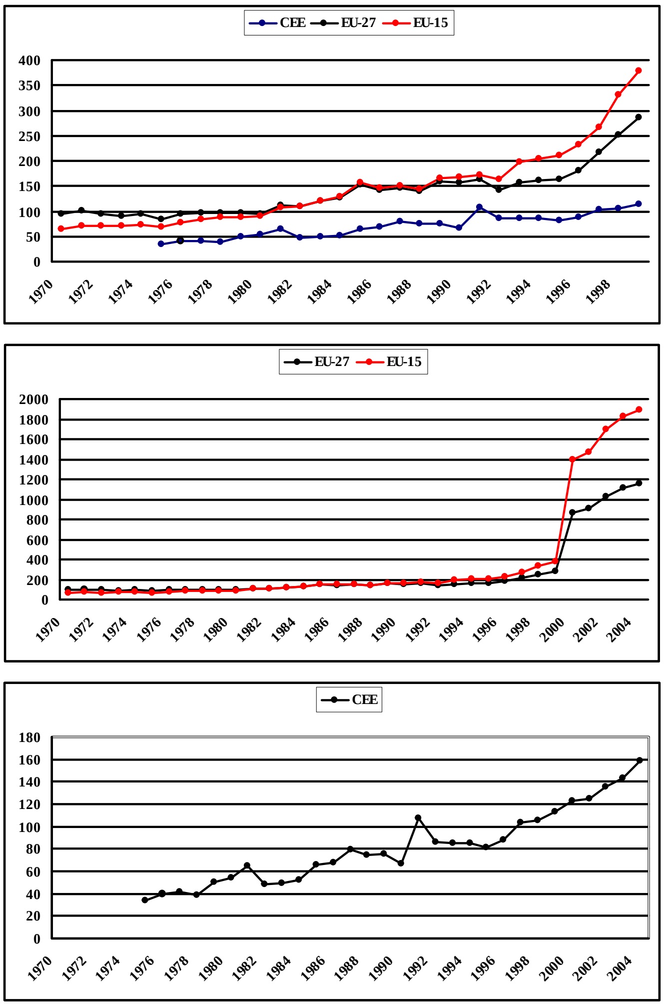

Table 3: CD Test Statistics

With an Intercept			
	ADF(1)	*ADF(2)*	*ADF(3)*
Real GDP per worker	22.68	21.70	21.45
I/Y	22.61	23.53	22.61
Stock of total assets and liabilities	28.89	28.13	28.06
FDI & Equity (%GDP)	31.02	30.26	30.31
Debt (%GDP)	23.21	22.66	22.50
Domestic money bank to CB assets	4.45	5.24	5.85
Liquid liabilities to GDP	1.10	3.90	4.47
Private credit to GDP	2.26	4.48	3.93
ΔReal GDP per worker	19.12	18.91	18.58
ΔI/Y	22.32	21.60	21.37
ΔStock of total assets and liabilities	28.15	27.94	27.70
ΔFDI & Equity (%GDP)	29.72	29.41	28.90
ΔDebt (%GDP)	22.38	22.11	21.81
ΔDomestic money bank to CB assets	3.54	3.43	2.78
ΔLiquid liabilities to GDP	2.58	3.87	3.63
ΔPrivate credit to GDP	2.46	2.03	1.90
With an Intercept and a Linear Trend			
	ADF(1)	*ADF(2)*	*ADF(3)*
Real GDP per worker	20.70	18.25	18.18
I/Y	21.02	21.99	21.42
Stock of total assets and liabilities	28.38	29.07	28.13
FDI & Equity (%GDP)	31.41	30.20	29.25
Debt (%GDP)	21.81	22.82	22.15
Domestic money bank to CB assets	3.00	3.11	4.61
Liquid liabilities to GDP	0.57	3.29	3.85
Private credit to GDP	1.09	2.25	2.69

Notes: p^{th}-order Augmented Dickey-Fuller test statistics, ADF(p), for y_{it}, i_{it}, fd_{it} and fi_{it} are computed for each cross section unit separately in two cases i) with an intercept only and ii) with an intercept and a linear time trend. $CD = \sqrt{2T/N(N-1)}\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\hat{\rho}_{ij}$, with $\hat{\rho}_{ij}$ being the correlation coefficient of the ADF(p) regression residuals between i^{th} and j^{th} cross section units, tends to $N(0,1)$ under the null hypothesis of no error cross section dependence.

Table 4: CIPS Panel Unit Root Test Results

With an Intercept			
	ADF(1)	*ADF(2)*	*ADF(3)*
Real GDP per worker	−1.615	−1.908	−1.812
I/Y	−2.144	−2.337**	−1.908
Stock of total assets and liabilities	−2.067	−2.323**	−2.082*
FDI & Equity (%GDP)	−1.998	−1.974	−1.869
Debt (%GDP)	−2.017	−2.304**	−2.178**
Domestic money bank to CB assets	−2.825***	−2.583***	−2.602***
Liquid liabilities to GDP	−1.384	−2.162*	−1.729
Private credit to GDP	−1.003	−1.971	−1.727
ΔReal GDP per worker	−3.982***	−3.046***	−2.532***
ΔI/Y	−5.018***	−4.188***	−3.529***
ΔStock of total assets and liabilities	−4.417***	−3.525***	−2.657***
ΔFDI & Equity (%GDP)	−5.238***	−3.775***	−2.561***
ΔDebt (%GDP)	−4.065***	−3.179***	−2.432***
ΔDomestic money bank to CB assets	−5.504***	−4.403***	−3.131***
ΔLiquid liabilities to GDP	−3.492***	−3.615***	−2.501***
ΔPrivate credit to GDP	−2.856***	−2.741***	−2.174**
With an Intercept and a Linear Trend			
	ADF(1)	*ADF(2)*	*ADF(3)*
Real GDP per worker	−1.480	−1.701	−1.563
I/Y	−2.233	−2.493	−1.961
Stock of total assets and liabilities	−1.659	−1.979	−1.674
FDI & Equity (%GDP)	−2.530	−2.387	−2.257
Debt (%GDP)	−1.554	−1.913	−1.695
Domestic money bank to CB assets	−2.814**	−2.360	−1.998
Liquid liabilities to GDP	−1.693	−2.533	−2.184
Private credit to GDP	−1.016	−1.879	−1.563

Notes: The reported values are CIPS(p) statistics, which are cross section averages of Cross-sectionally Augmented Dickey-Fuller (CADF(p)) test statistics (Pesaran 2007); see Section 3 for more details. The relevant lower 1, 5, and 10 percent critical values for the CIPS statistics are –2.34, -2.17, and -2.07 with an intercept case, and –2.89, -2.70, and -2.60 with an intercept and a linear trend case, respectively. Symbols denote *10%, **5%, ***1% rejections.

Table 5: MG and FE Estimation Results (Dependent Variable: Real GDP per Worker)

	MG					FE				
I/Y	0.26*** (0.031)	−0.02 (0.080)	0.09 (0.091)	0.16*** (0.064)	0.19*** (0.048)	0.27*** (0.025)	−0.16 (0.127)	−0.01 (0.058)	−0.003 (0.057)	0.01 (0.059)
Private Credit to GDP		0.32*** (0.066)		0.14*** (0.046)	0.09** (0.040)		0.28*** (0.029)		0.13*** (0.029)	0.14*** (0.034)
Stock of total assets and liabilities			0.24*** (0.040)	0.18*** (0.045)				0.25*** (0.016)	0.19*** (0.021)	
Debt (%GDP)					0.05 (0.051)					0.18*** (0.035)
FDI & Equity (%GDP)					0.10** (0.045)					0.01** (0.005)
CD Test Statistics (EU26)	6.93	17.26	9.75	10.02	12.17	9.44	31.78	7.06	6.61	8.88
CD Test Statistics (EU15)	11.55	16.74	11.49	14.54	13.41	9.04	16.65	6.84	5.61	7.31

Notes: MG and FE stand for the Mean Group and Fixed Effects estimates, respectively. Standard errors are given in parenthesis. Symbols denote *10%, **5%, ***1% rejections.

Table 6: CCE Estimation Results (Dependent Variable: Real GDP per Worker)

	CCEMG					CCEP				
I/Y	0.21*** (0.023)	0.21*** (0.030)	0.22*** (0.036)	0.22*** (0.026)	0.14*** (0.031)	0.22*** (0.028)	0.21*** (0.043)	0.24*** (0.038)	0.25*** (0.036)	0.21*** (0.034)
Private Credit to GDP		0.11** (0.048)		0.06** (0.026)	0.04 (0.031)		0.07*** (0.016)		0.01 (0.016)	−0.01 (0.014)
Stock of total assets and liabilities			0.04 (0.037)	0.05* (0.030)				0.05** (0.030)	0.06* (0.031)	
Debt (%GDP)					0.05** (0.025)					0.18* (0.022)
FDI & Equity (%GDP)					0.02 (0.016)					−0.00 (0.002)
CD Test Statistics (EU26)	4.57	16.92	17.57	16.30	13.15	4.16	22.49	20.54	20.61	19.68
CD Test Statistics (EU15)	−3.37	0.50	−0.81	0.49	−1.57	−3.85	−3.75	−3.75	−3.94	−3.70

Notes: CCEMG and CCEP stand for the Common Correlated Effects Mean Group and Pooled estimates, respectively. Standard errors are given in parenthesis; see Section 3 for more details. Symbols denote *10%, **5%, ***1% rejections.

Table 7: Pedroni Panel Cointegration Test Results

Raw data			Demeaned data		
ρ-Statistic	PP	ADF	ρ-Statistic	PP	ADF
3.50^{***}	-1.84^{*}	-3.41^{***}	4.90^{***}	-0.33	-2.02^{**}

Notes: ρ-Statistic, PP, and ADF columns report the Pedroni (1999, 2004) group mean tests for null of no cointegration. Fixed effects and heterogeneous trends have been included in all cases. Symbols denote *10%, **5%, ***1% rejections.

Table 8: FMOLS Estimation Results (Dependent Variable: Real GDP per Worker)

	Raw data		Demeaned data	
I/Y	0.26^{***} (0.015)	0.16^{***} (0.018)	0.42^{***} (0.017)	0.30^{***} (0.018)
Private Credit to GDP	0.12^{***} (0.008)	0.11^{***} (0.010)	0.14^{***} (0.010)	0.08^{***} (0.006)
Stock of total assets and liabilities	0.20^{***} (0.007)		-0.12^{***} (0.028)	
Debt (%GDP)		0.10^{***} (0.006)		0.04^{***} (0.007)
FDI & Equity (%GDP)		0.10^{***} (0.005)		-0.07^{***} (0.006)

Notes: The estimates are based on the Pedroni (2000) group mean FMOLS estimator. Standard errors are given in parenthesis. Column labeled "demeaned" refers to results relative to means, comparable to the inclusion of common time effects. Symbols denote *10%, **5%, ***1% rejections.

A Data Appendix

The sample consists of 26 European countries with annual data during the period 1970–2004. Data for real GDP per worker and investment share of real GDP per capita are obtained from Summers & Heston (1991). We use three different measures of domestic financial development taken from the Beck, Demirguc-Kunt and Levine, (2006) database. The first one is the ratio of deposit money bank claims on domestic nonfinancial real sector to the sum of deposit money bank and Central Bank claims on domestic nonfinancial real sector. The second measure is the Liquid Liabilities of the financial system to GDP, which is defined as currency plus demand and interest bearing liabilities of bank and non-bank financial intermediaries divided by GDP. This is the broadest measure of financial depth used, since it includes all types of financial institutions (central bank, money banks, and other financial institutions). The third indicator, Private Credit to GDP, equals the aggregate private credit provided by banks and other financial institutions as a share of GDP. The quantity-based indicators of international financial integration that we use in this paper draw upon the pioneering work of Lane and Milesi-Ferretti (2007), who have assembled an extensive dataset of total foreign assets and liabilities for 145 countries over the period 1970-2004. Their dataset also contains information about the composition of international financial positions, including FDI, international portfolio equity, external debt, and official reserves.